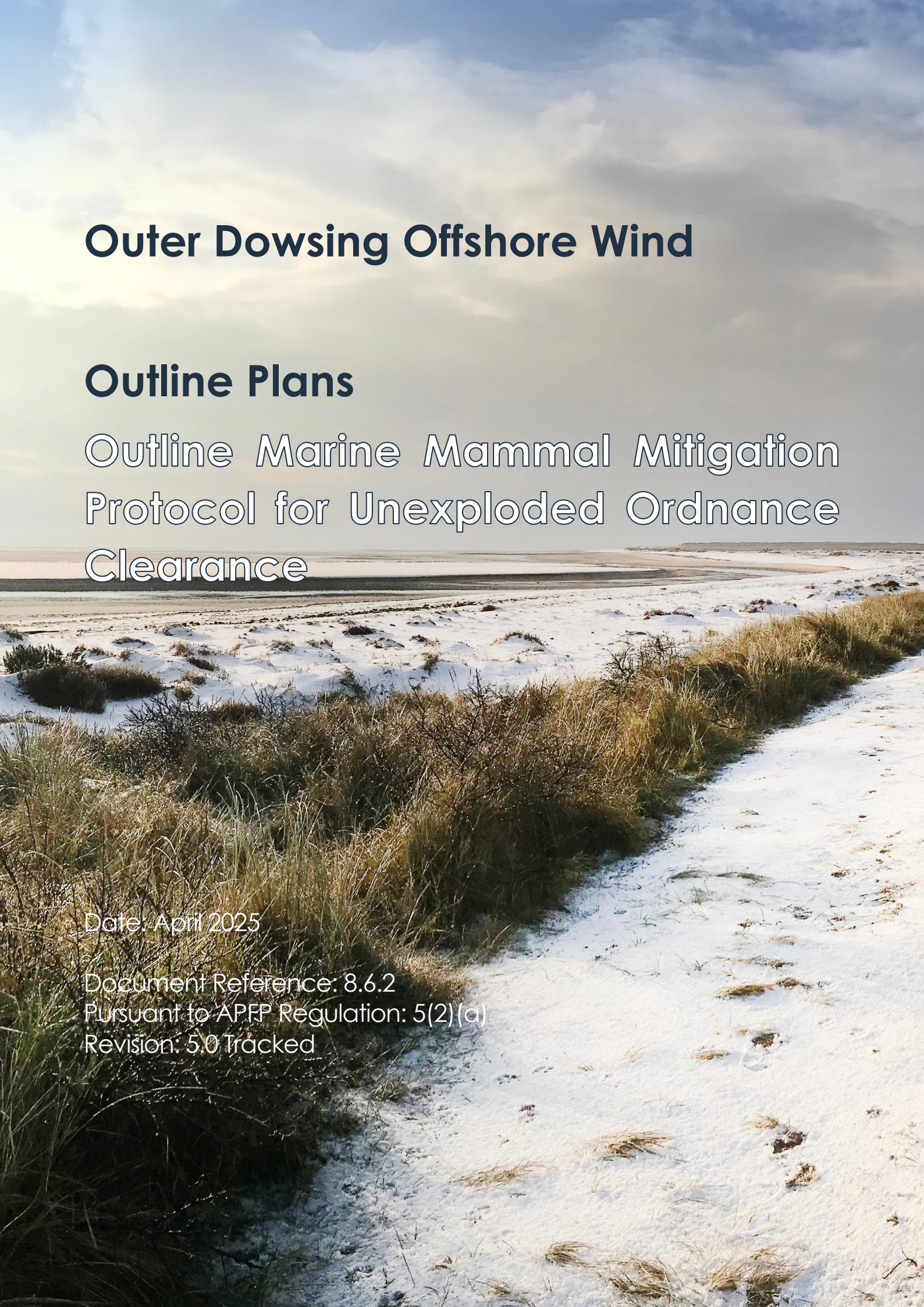

Outer Dowsing Offshore Wind

Outline Plans

Outline Marine Mammal Mitigation Protocol for Unexploded Ordnance Clearance

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5.0	April 2025	Deadline 6 Examination Submission	GoBe	Outer Dowsing	Shepherd & Wedderburn	Outer Dowsing

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Acronyms & Terminology

Abbreviations / Acronyms

Abbreviation / Acronym	Description
ADD	Acoustic Deterrent Device
dB	Decibel
DCO	Development Consent Order
dML	deemed Marine Licence
EIA	Environmental Impact Assessment
EPS	European Protected Species
ES	Environmental Statement
HF	High Frequency
HRA	Habitat Regulations Assessment
JNCC	Joint Nature Conservation Committee
kg	Kilogram
km	Kilometre
km^2	Square Kilometre
LF	Low Frequency
m	Meter
MDS	Maximum Design Scenario
ML	Marine Licence
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MMOb	Marine Mammal Observer
m/s	Metres per second
NAS	Noise Abatement System
NSIP	Nationally Significant Infrastructure Project
ODOW	Outer Dowsing Offshore Wind (The Project)
OP	Offshore Platform
OWF	Offshore WindFarm
PAM	Passive Acoustic Monitoring
PTS	Permanent Threshold Shift
ROV	Remote Operated Vehicle
SEL	Sound Exposure Level
SEL_{cum}	Cumulative Sound Exposure Level
SIP	Site Integrity Plan
SPL	Sound Pressure Level
SPL_{peak}	Peak Sound Pressure Level
SNCB	Statutory Nature Conservation Bodies
SNS	Southern North Sea
SoS	Secretary of State
UK	United Kingdom
UXO	Unexploded Ordnance
cUXO	confirmed Unexploded Ordnance
pUXO	potential Unexploded Ordnance

Abbreviation / Acronym	Description
VHF	Very High Frequency
WBD	White Beaked Dolphin
WCS	Worst-case Scenario
WTG	Wind Turbine Generator
µPa	Micropascal

Terminology

Term	Definition
Array Area	The area offshore within which the generating station (including wind turbine generators (WTG) and inter array cables), offshore accommodation platforms, offshore transformer substations and associated cabling will be positioned, including the ORBA.
Baseline	The status of the environment at the time of assessment without the development in place.
deemed Marine Licence (dML)	A marine licence set out in a Schedule to the Development Consent Order and deemed to have been granted under Part 4 (marine licensing) of the Marine and Coastal Access Act 2009.
Designated Site	Sites designated for nature conservation under the Habitats Directive and Birds Directive. This includes candidate Special Areas of Conservation (SAC), Sites of Community Importance, Special Protection Areas (SPA), and is defined in Regulation 8 of the Conservation of Habitats and Species Regulations 2017.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP) from the Secretary of State (SoS) for Department for Energy Security & Net Zero (DESNZ).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of an impact with the sensitivity of a receptor, in accordance with defined significance criteria.
EIA Regulations	Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Regulations, including the publication of an Environmental Statement (ES).
Evidence Plan	A voluntary process of stakeholder consultation with appropriate Expert Topic Groups (ETGs) that discusses and, where possible, agrees the detailed approach to the Environmental Impact Assessment (EIA) and information to support Habitats Regulations Assessment (HRA) for those relevant topics included in the process, undertaken during the pre-application period.

Term	Definition
Habitat Regulations Assessment (HRA)	A process which helps determine likely significant effects and (where appropriate) assesses adverse effects on the integrity of European conservation sites and Ramsar sites. The process consists of up to four stages of assessment: screening, appropriate assessment, assessment of alternative solutions, assessment of imperative reasons of over-riding public interest (IROPI) and compensatory measures.
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Landfall	The location at the land-sea interface where the offshore export cable will come ashore.
Maximum Design Scenario	The maximum design parameters of the combined project assets that result in the greatest potential for change in relation to each impact assessed.
Mitigation	Mitigation measures, or commitments, are commitments made by the Project to reduce and/or eliminate the potential for significant effects to arise as a result of the Project. Mitigation measures can be embedded (part of the Project Design) or secondarily added to reduce impacts in the case of significant effects.
Offshore Export Cable Corridors (ECC)	The Offshore Export Cable Corridor (Offshore ECC) is the area within the Order Limits within which the export cables running from the array to landfall will be situated.
Offshore Substation (OSS)	A structure attached to the seabed by means of a foundation, with one or more decks and a helicopter platform (including bird deterrents), containing— (a) electrical equipment required to switch, transform, convert electricity generated at the wind turbine generators to a higher voltage and provide reactive power compensation; and (b) housing accommodation, storage, workshop auxiliary equipment, radar and facilities for operating, maintaining and controlling the substation or wind turbine generators
Outer Dowsing Offshore Wind (ODOW)	The Project.
Order Limits	The area subject to the application for development consent, The limits shown on the works plans within which the Project may be carried out.
Peak Sound Pressure Level	Characterised as a transient sound from impulsive noise sources, it is the maximum change in positive pressure as the wave propagates.
Preliminary Environmental Information Report (PEIR)	The PEIR was written in the style of a draft Environmental Statement (ES) and provided information to support and inform the statutory consultation process during the pre-application phase.
Pre-construction	The phases of the Project before construction takes place.
Sound Exposure Level	Measure that considers both the received level of the sound and duration of exposure.
Sound Pressure Level	Measure of the sound pressure within the water column.
Receptor	A distinct part of the environment on which effects could occur and can be the subject of specific assessments. Examples of receptors

Term	Definition
	include species (or groups) of animals or plants, people (often categorised further such as 'residential' or those using areas for amenity or recreation), watercourses, etc.
The Applicant	GTR4 Limited (a joint venture between Corio Generation (and its affiliates), TotalEnergies and Gulf Energy Development), trading as Outer Dowsing Offshore Wind.
The Project	Outer Dowsing Offshore Wind including the proposed offshore and onshore infrastructure.
Wind Turbine Generator (WTG)	A structure comprising a tower, rotor with three blades connected at the hub, nacelle and ancillary electrical and other equipment which may include J-tube(s), transition piece, access and rest platforms, access ladders, boat access systems, corrosion protection systems, fenders and maintenance equipment, helicopter landing facilities and other associated equipment, fixed to a foundation

Reference Documentation

Document Number	Title
6.1.3	Project Description
6.11.1	Marine Mammals
6.3.3.2	Underwater Noise Assessment

1 Introduction

1.1 Project Background

1. GT R4 Limited, (trading as Outer Dowsing Offshore Wind (ODOW), hereafter referred to as the "Applicant"), is proposing to develop Outer Dowsing Offshore Wind ("the Project"). The Project array area will be located approximately 54km from the Lincolnshire coastline in the southern North Sea. It will include both offshore and onshore infrastructure including an offshore generating station (windfarm), export cables to landfall, Offshore Reactive Compensation Platforms (ORCP), onshore cables, connection to the electricity transmission network, ancillary and associated development areas for the delivery of up to two Artificial Nesting Structures (ANS) for the creation and recreation of a biogenic reef (if these compensation measures are deemed to be required by the Secretary of State) ((see Volume 1, Chapter 3: Project Description (document reference 6.1.3) for full details).

1.2 Purpose of this document

2. The primary objective of this Outline Marine Mammal Mitigation Protocol (MMMP) for Unexploded Ordnance (UXO) Clearance is to detail the potential contingency measures which could be used by the Project to manage the risk of permanent threshold shift (PTS) auditory injury to marine mammal species arising from UXO clearance operations to a negligible level. This document incorporates guidance from the Joint Nature Conservation Committee (JNCC) regarding the use of Acoustic Deterrent Devices (ADD) (McGarry, 2020), and established industry best practices, policy and guidance (UK Government 2025; JNCC, 2025).
3. The measures outlined in this document should be considered as examples of potential mitigation measures which could be employed by the Project at the point of construction to provide confidence to stakeholders that the proposed MMMP will be sufficient to ensure the risk of injury is as low as reasonably practicable. It is not intended to identify specific mitigation measures that will be implemented during UXO clearance as this will be determined prior to construction by the Project in consultation with the regulators and their advisors as part of the application for a Marine Licence for UXO clearance. Prior to the commencement of offshore construction for the Project, a marine licence will be applied for to consent the investigation of potential UXOs (pUXO) and the clearance of confirmed UXO (cUXO); a formal UXO clearance MMMP will be drafted and submitted as part of the marine licence application, which will be based on the best available evidence at that point in time.
4. Whilst the clearance of UXO will be licensed through a separate consent due to the degree of uncertainty regarding the number of UXO which may need clearing, as a reasonably foreseeable activity, the impacts from UXO clearance have been assessed within the relevant chapters of the Environmental Statement (ES) alongside the Development Consent Order (DCO) application. The Project has developed commitments during the Environmental Impact Assessment (EIA) process to minimise potential impacts to marine mammals, which involves the creation and implementation of an UXO clearance MMMP ((see Volume 1, Chapter 11: Marine Mammals (document reference 6.11.1) for full details).

5. Therefore, this Outline UXO MMMP is intended to demonstrate that effective mitigation measures are available to mitigate the impacts of UXO clearance to negligible, however the actual measures proposed within the marine licence application pre-construction will be based on best practise and up to date evidence, at that point in time, rather than being constrained by the options outlined herein.

2 UXO Clearance Scenarios

6. The need for UXO clearance is expected before construction of the Project. This requirement arises from the proximity of the Project area to historical military airfields and coastal towns of strategic importance during World War Two. While efforts will be made to avoid any underwater UXO, it is essential to address the possibility of underwater UXO detonation when retrieval is unsafe, or avoidance is impractical.
7. At this stage of the Project, the Applicant is unable to quantify the number of potential UXO detonations which may be required prior to construction. A magnetometer survey (to identify ferrous contacts) would be performed within the array area, export cable corridor, and any other construction areas such as nesting structure installation sites. This would be performed prior to construction and the results of which would identify potential UXO and UXO hazards. Where identified ferrous contacts are confirmed as UXO, or possibly UXO, verification or dismissal as suspect UXO shall first be sought via corroboration with dimensions of common charge sizes and types. In some instances where such corroboration is inconclusive, visual assessment by Remotely Operated Vehicle may be needed to confirm. It is important that these surveys and the associated clearance campaigns are undertaken much closer to the point of construction to ensure that any determination of the risk to the construction remains as low as reasonably possible (ALARP), with these certificates being time limited in part due to the risk of migration of previously unidentified UXO into the construction area.
8. Whilst the Applicant's primary approach will be avoidance, in cases where this is not possible and clearance is required then low order detonations will be utilised~~,~~ as the default method for clearance, in line with ~~high~~UK Government (2025). High order detonations will only be used in cases where low order is not possible~~.~~ and as a last resort. In line with UK Government (2025) this is when:
   - The most appropriate low noise method has failed after a minimum of 3 attempts;
   - All best practice has been demonstrably applied; and
   - There is prior agreement with the appropriate licensing authority.

~~8.~~9. It is not currently known the size or type of the UXO that could be present in the area, therefore a range of charge sizes have been considered in Chapter 11 (document reference 6.11.1) and Volume 3, Appendix 3.2: Underwater noise assessment (document reference 6.3.3.2)), with a maximum charge weight of up to 800kg + 0.5 kg donor charge assumed. The assumptions used throughout the ES and this MMMP are predicated based on the maximum charge sizes recorded at neighbouring offshore windfarms or the maximum charges consented within the relevant marine licence applications for those projects.

~~9.~~10. The maximum charge weight assumed herein is therefore considered to provide a good baseline for predicting and measuring the worst-case effects of any UXO that could be encountered within the Project area.

3 Summary of Potential Impact Ranges

~~10.~~11. An estimation of source level and predicated PTS-onset impact ranges were calculated for a range of expected UXO sizes and presented in Table 3.1. The maximum charge weight for the potential UXO devices that could be present within the Project Order Limits has been estimated as 800kg. This has been modelled alongside a range of smaller high-order charges at 25, 55, 120, 240, 525 and 700kg. In addition, a low-order deflagration has been modelled, which assumes that the donor or shaped-charge (charge weight 0.5kg[1]) detonates fully but without the follow-up detonation of the UXO. No mitigation measures have been considered for the modelling of the impact ranges from the detonation of high order and low order charges.

[1] It should be noted that a charge weight of 0.5kg is considered highly conservative for a low order charge based on the results of Robinson *et al.* (2022).

Table 3.1: PTS-onset impact ranges (in km) for UXO detonation using as per the impulsive noise criteria from Southall *et al.* (2019). For all charge sizes above 25kg a donor of 0.5kg is assumed.

Species	Threshold	Charge size							
		0.5kg	25kg + donor	55kg + donor	120kg + donor	240kg + donor	525kg + donor	700kg + donor	800kg + donor
Unweighted SPL_{peak}									
Harbour porpoise (*Phocoena phocoena*)	202dB re 1µPa (VHF)	1.2	4.6	6.0	7.8	9.8	12.0	14.0	14.0
Bottlenose dolphin (*Tursiops truncatus*) & white-beaked dolphin (*Lagenorhynchus albirostris*)	230 dB re 1µPa (HF)	0.07	0.26	0.34	0.45	0.56	0.73	0.81	0.84
Minke whale (*Balaenoptera acutorostrata*)	219 dB re 1µPa (LF)	0.22	0.82	1.0	1.3	1.7	2.2	2.4	2.6
Harbour seal (*Phoca vitulina*) & grey seal (*Halichoerus grypus*)	218 dB re 1µPa (PCW)	0.24	0.91	1.1	1.5	1.9	2.5	2.7	2.8
Weighted SEL_{ss}									
Harbour porpoise	155 dB re 1µPa (VHF)	0.11	0.57	0.74	0.95	1.1	1.4	1.5	1.6
Bottlenose dolphin & white-beaked dolphin	185 dB re 1µPa (HF)	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.06	0.06

Species	Threshold	Charge size							
		0.5kg	25kg + donor	55kg + donor	120kg + donor	240kg + donor	525kg + donor	700kg + donor	800kg + donor
Minke whale	183 dB re 1µPa (LF)	0.32	2.2	3.2	4.7	6.5	9.5	10.0	11.0
Harbour seal & grey seal	185 dB re 1µPa (PCW)	0.06	0.39	0.57	0.83	1.1	1.6	1.9	2.0

4 Mitigation Methodology

4.1 Introduction

~~11.~~12. In order to minimise the risk of any auditory injury to marine mammals from underwater noise during UXO clearance operations, there are a variety of mitigation measures that the Applicant could implement in any combination for UXO clearance. These mitigation measures may include (but are not limited to) the following options:

- A magnetometer survey within Order Limits where it is proposed to undertake works to detect potential UXO and UXO hazards, to allow for the avoidance of any magnetic contacts if possible;
- Low-order clearance techniques, such as deflagration, will be default method for clearance (UK Government, 2025);
- High order clearance as a contingency measure should it be required (UK Government, 2025);
- The use of bubble curtains if any high-order detonation is required (taking into consideration the environmental limitations);
- All UXO clearance operations to take place during day light hours and~~, when possible,~~ in favourable weather conditions with good visibility (i.e. a sea state of 3 or less) in line with JNCC (2025);
- Establishment of a monitoring area with a minimum of 1-km radius. The observation of the monitoring area will be performed by dedicated and trained marine mammal observers (MMObs) during daylight hours and under suitable visibility;
- Deployment of passive acoustic monitoring (PAM) systems, if required, and if equipment can be safely deployed and retrieved;
- The activation of an acoustic deterrent device (ADD);
- Other UXO clearance techniques, such as avoidance of UXO; or relocation of UXO. If more than one high-order detonation is required, other measures such as the use of scare charges; or multiple detonations, if UXO are in close proximity, will also be considered in consultation with the Marine Management Organisation (MMO) and Statutory Nature Conservation Bodies (SNCB).

~~12.~~13. The UXO clearance mitigation measures for the Project will be determined in consultation with relevant SNCBs once charge weights, survey data, noise data, and information on maturation of emerging technologies are confirmed. These additional data and information will inform noise modelling to be fed into the UXO Clearance MMMP and discussions on suitable mitigation measures.

~~13.~~14. The following sections provide a high-level outline of the information which would be contained within the UXO MMMP that will accompany a future Marine Licence application.

4.2 Mitigation Zone

~~14.~~15. The mitigation zone will be defined as the maximum potential instantaneous PTS-onset impact range. The Applicant will update the noise modelling prior to construction once the final UXO parameters are known. For low order clearance the JNCC (2025) recommends a mitigation zone of the full extent within which PTS could occur or a 1 km radius, whichever is larger. The actual mitigation zone for UXO detonation will be determined based on the final noise modelling data, confirmed charge sizes and detonation methods. For both low and high order clearances, at least two dedicated MMObs should work together to monitor it, due to the minimum size of the mitigation area (JNCC, 2025) and ideally, at least one MMOb should be on an elevated platform.

4.3 Pre-UXO Clearance

Marine Mammal Observers (MMOb)

~~15.~~16. JNCC (2025) recommends a minimum 60-minute pre-detonation search by a qualified MMOb(s) within the visual mitigation zone for both low order and high order UXO detonation and a 30-minute search prior to ADD activation[2]. The Project commits to following the JNCC (2025) recommendation of a 30-minute search prior to ADD activation, or the most recent available guidance at the time of UXO clearance with respect to this measure. A qualified MMOb(s) would record monitoring periods, environmental conditions, and marine mammal sightings following the JNCC guidelines recommendation. Identified behavioural responses to ADD activation would also be documented.

~~16.~~17. If a marine mammal is detected within the mitigation zone during the pre-detonation search, the operation would be delayed until the MMOb confirms its departure from the mitigation zone and ensures a safe distance (defined as the PTS-onset range for the Project). The ADD's operation would be checked concurrently, and the MMOb would continue to monitor for sightings and animal behaviour.

~~17.~~18. ~~.~~Specific details on MMObs and methods will be updated in the UXO MMMP, considering any available guidance at that time.

[2] ADDs will be used for their required time in conjunction with the visual watch. This may require the total visual watch time to be longer than 1 hour when the ADD activation time is longer than 30 minutes.

Passive Acoustic Monitoring (PAM)

~~18.~~19. A PAM system, operated by a trained operator, may be used to supplement visual monitoring during daylight ~~and~~if species that are difficult to detect may be present or in ~~conditions~~areas that are of ~~reduced visibility (e.g., night, fog, high sea state~~ importance to marine mammals (as per JNCC, 2023; JNCC, 2025). If an animal is acoustically detected, the PAM operator would assess whether it is within the mitigation zone. If uncertainty exists about the exact location of the marine mammal, the PAM operator would recommend delaying UXO operations. Like a visual search, PAM monitoring should begin at least 60 minutes before the planned clearance.

ADD Choice and Specification

~~19.~~20. The standard ADD used in UK waters at the point of writing is the Lofitech AS seal scarer. This ADD has demonstrated consistent effectiveness in deterring harbour seals, grey seals, harbour porpoises and minke whales, especially in conditions similar to offshore windfarm (OWF) construction sites (Sparling *et al*., 2015; McGarry *et al*., 2017). It has a successful track record in marine mammal mitigation at various European OWF projects, including C-Power Thornton Bank OWF in Belgium (Haelters *et al.,* 2012), Horns Rev II, Nysted and Dan Tysk OWFs in Denmark (Carstensen *et al.,* 2006; Brandt *et al.,* 2016), and has been widely used for UK projects including Hornsea Project One, Hornsea Project Two, Dogger Bank A and the Sofia Offshore WindFarm UXO campaign amongst others.

~~20.~~21. The evidence available suggests that the Lofitech ADD can be highly effective in deterring harbour porpoise to at least 7.5 km with deterrence observed to 15 km range (Brandt *et al.,* 2013a; Brandt *et al.,* 2013b). Furthermore, a recent study also showed that after a 15 minute ADD exposure, in a 3-hour period after exposure there was a 50% probability of a significant behavioural response in harbour porpoise out to a range of 21.7 km (Thompson *et al*., 2020).

~~21.~~22. The ORJIP review suggested that for grey and harbour seals, ADDs could be effective at a range of approximately 1,000m (e.g. Götz and Janik, 2010; Götz, 2008). In addition, field trials have been carried out in the Moray Firth (Gordon *et al*., 2015), the results of which demonstrate that harbour seals exhibited aversive responses to the Lofitech seal scarer ADD signals in all trials at initial ranges of 1,000m or less.

~~22.~~23. A recent study of the effects of the Lofitech ADD on minke whales demonstrated significant deterrent reactions, including directed movement away from the ADD and a significant increase in swim speed (McGarry *et al*., 2017). Exposures were carried out at 500 m and 1,000 m from the device and significant responses were seen at both ranges. In this study, whales responding to the ADD were tracked to beyond the limit of the visible range, which was approximately 4,000 m, therefore deterrence behaviour is likely to extend beyond this range for minke whales.

~~23.~~24. It is worth noting that the ORJIP review (Sparling *et al.,* 2015) concluded that given detection probabilities of traditional passive methods of mitigation (visual observers and passive acoustic monitoring) would be significantly less than 100% for harbour porpoise and seals, ADDs were likely better than traditional passive methods at reducing risk of injury.

~~24.~~25. Currently, there is no available published evidence demonstrating the effectiveness of ADDs on white-beaked dolphins (*Lagenorhynchus albirostris*) or bottlenose dolphins (*Tursiops truncatus*). However, it is important to note that these deterrents only need to be effective within a limited range for white-beaked and bottlenose dolphins to mitigate the risk of auditory injury. Additionally, considering the lower densities of these species in the area compared to harbour porpoises, the likelihood of encountering white-beaked or bottlenose dolphins at the site is significantly reduced.

~~25.~~26. It is important to note that there may be additional ADD models identified in the pre-construction phase for the Project that are available and suitable for use at that point in time. As such, if an ADD is identified as a mitigation measure within the Final Piling MMMP, the final ADD choice and specification would follow current best practice as advised by the relevant SNCB and would be approved by the MMO.

ADD Deployment Procedure

~~26.~~27. If an ADD is used during UXO detonation, one ADD would be deployed from the vessel, with the control unit and power supply on board in safe positions. Verification of ADD operations would be required before pre-detonation activation. The deployment procedure would be determined with the UXO contractor and would adhere to safe, standard practices, using experienced/trained staff to ensure proper ADD equipment use within varying vessel layouts.

ADD Duration of Deployment

~~27.~~28. The duration of ADD deployment would be calculated based on assumed swimming speeds to ensure that marine mammals are safely outside the mitigation zone when piling begins. An assumed swim speed of 1.5m/s would be applicable to all marine mammals except minke whales, for which a speed of 3.25m/s, would be assumed. These selected swim speeds are considered precautionary, as evidence suggests that animals often flee at much higher initial speeds. For instance, studies indicate that minke whales can flee ADDs at an average speed of 4.2m/s (McGarry *et al.*, 2017).

~~28.~~29. A study by Kastelein *et al.* (2018) demonstrated that captive harbour porpoises responded to pile driving sounds by swimming at significantly higher speeds than their baseline, reaching speeds of up to 1.97m/s sustained for a 30-minute test period. Another study by van Beest *et al.* (2018) showed that a harbour porpoise responded to airgun noise exposure with a fleeing speed of 2m/s.

~~29.~~30. During ADD operation, marine mammals are expected to continue moving away from the noise source. Additionally, the presence of other construction-type vessel activity on-site would be likely to induce animals to move away from the mitigation zone prior to commencement of detonation works.

ADD Operator Training and Responsibilities

~~30.~~31. A trained ADD operator would be responsible for ADD maintenance, operation, and reporting. Their duties would include deploying the ADD, verifying its operation, maintaining charged batteries and spare equipment, recording and reporting ADD and detonation activities. Before the MMOb's pre-detonation watch, the ADD operator would test and deploy the ADD to the agreed depth and distance. When the ADD is activated, the MMOb would ensure the mitigation zone is clear before the commencement of any UXO detonation.

4.4 Noise Abatement

~~31.~~32. UK Government (2025) policy states that high order clearance should only be used as contingency measure of last resort when there are circumstances that mean low order clearance cannot be undertaken. Technologies are available which attenuate the amount of noise emitted at the source (noise abatement). The use of bubble curtains during high-order UXO clearance activities is now standard best-practise for UXO clearance campaigns for offshore wind projects, with all projects since East Anglia One being required to use bubble curtains (subject to certain environmental limitations) for UXO detonations with combined charge sizes of greater than 50kg (TNT-equivalent). JNCC (2025) guidelines identify the need for noise abatement measures for high order detonations. It is expected that noise abatement measures such as bubble curtains will be used for all high order clearance events including those under 50 kg TNT equivalent.

~~32.~~33. An alternative approach to high-order explosive detonations would be low-order detonation, including a technique known as deflagration. Deflagration involves the sub-sonic burning of the explosive material, without generating an explosion, using a small, shaped charge which creates a plasma jet that penetrates the casing of the UXO and ignites the explosive material. Field measurements that compare low-order and high-order detonations reveal a significant reduction in peak sound levels and the overall acoustic energy of the detonation when deflagration is employed. It is worth noting that deflagration has been in use by the UK military since the early 2000s (Merchant and Robinson, 2019). Low noise methods are now considered the default method for clearance (UK Government, 2025). Deflagration is now recommended as the primary detonation methodology to be used for UXO clearance by the MMO and JNCC (2025) guidelines, and recent Marine Licence applications have promoted the use of this methodology, with high-order clearance as a back-up option in the event deflagration is not possible or fails.

~~33.~~34. It is anticipated that a combination of MMOb, PAM, short-duration ADD for both low and high-order detonations, and bubble curtains for high-order detonations would be more likely to reduce UXO clearance associated noise impacts on marine mammals.

4.5 Delays in Commencement of UXO Detonation

~~34.~~35. This section will provide details of the process which would be followed in the event of a delay in the commencement of UXO detonation once the ADD has been activated.

~~35.~~36. If there is a delay in the commencement of UXO detonation, there would be a risk of animals re-entering the mitigation zone if ADDs are switched off. However, turning on ADDs for extended periods may lead to habituation. Therefore, ADDs would be promptly turned off during delays and reactivated when detonation is ready to commence. The break in ADD would be for greater than 20 minutes to ensure startle and flee responses once the ADD is reactivated. ADDs would be used for the minimum duration needed to ensure animals leave the mitigation zone, alongside ongoing visual and/or acoustic monitoring. The MMOb would continue visual searches during this time.

4.6 Communications

~~36.~~37. The UXO MMMP will specify a communication protocol for implementing marine mammal mitigation measures, including any UXO detonation delays due to marine mammal presence. It would also outline the roles and responsibilities of key personnel to ensure these mitigation measures are effectively carried out. Personnel details and roles will be finalised based on contractual agreements and mitigation needs.

4.7 Reporting

~~37.~~38. Reports on UXO clearance and mitigation measures will be prepared, including, but not limited to:

- Activity reference number (if applicable);
- Date and location of act;
- Operation details (e.g., charge size, detonation start times, watch times by MMOb(s), PAM use);
- Summarised marine mammal sightings using “Marine Mammal Recording Forms”;
- Information on ADD and its effectiveness; and
- Noted problems and instances of non-compliance with JNCC guidelines.

~~38.~~39. The final report will cover detonation events, mitigation methods, issues, sightings, behavioural observations, and potential protocol improvements.

5 References

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